

Microstrip Antenna with Photographic Paper Substrate for WLAN

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ABSTRACT

In this paper a compact, flexible, Multiband antenna is designed. It is having flexible Substrate of photographic paper which makes the antenna conformal. The antenna with two U slots cut in radiating patch is offset fed by microstrip lines gives the multiple bands of WLAN/WIMAX Application and two parasitic Elements improves the bandwidth of a typical microstrip antenna. The Measured results shows that the antenna resonates between Frequency band 2.10-2.95 GHz, 3.35-3.54 GHz and 5.04-6.0Hz. which are used for application such as Bluetooth, Wi-Fi, Zigbee, ISM 2.4GHz, WLAN WiMAX, and WLAN 5.2GHz.

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1. INTRODUCTION

Demand for compact and multifunctional wireless communication systems has spurred the development of multiband and wideband antennas with small size. Microstrip patch antennas are widely used in this regard as they offer compactness, a low profile, light weight, and economical efficiency. However, the microstrip patch antenna is limited by its narrow operating bandwidth.

There are numerous and well-known methods to increase the band-width of antennas, including increase of the substrate thickness [1], the use of a low dielectric substrate [1], the use of various impedance-matching and feeding techniques [2], the use of multiple resonators [3]–[7], and the use of slot antenna geometry [8]. However, the size antenna and the bandwidth of an antenna are generally mutually conflicting properties, that is, improvement of one of the characteristics normally results in degradation of the other.

Recently, several techniques have been proposed to enhance the bandwidth. In [9]–[11], utilizing the shorting pins or shorting walls on the unequal arms of a U-shaped patch, U-slot patch, or L-probe feed patch antennas, wideband and dual-band impedance bandwidth have been achieved with electrically small size.

In this work, a Multiband microstrip patch antenna employing parasitic elements is investigated. Two rectangular shaped parasitic elements are incorporated along the radiating edges of an offset fed rectangular patch antenna so as to get desirable bandwidth for WLAN. Due to the attractive characteristics, such as flexible, low cost and cellulose in nature, paper substrates have received much attention in recent years and become the most potential candidate of the wireless applications. Paper possesses great superiority than any other substrate for its wide availability, the high application the cheapest material and eco-friendly [4][5][6][10]. Paper is suited for reel-to-reel processing and employing fast process, such as inkjet printing, which can be used efficiently to print electronics on paper substrate [4]. In addition, the characteristics of low thickness and low weight make paper substrates applied to the wearable devices used for monitoring, cheap and flexible RFID tags [5]. The direct-write inkjet printing is an emerging technique by which the design structure is transferred

directly to the substrate, unlike etching. This process is considered as a low-cost and no-waste fabrication process for electronics recently which do not need remove unwanted metal from substrate surface [12].

In this paper a multiband antenna is designed using inkjet printing method on photographic paper substrate for different applications of wireless communication. The design of the antenna is simulated and optimized by High Frequency Simulation Software (HFSS).

2. GEOMETRY OF ANTENNA

The geometry of proposed antenna is shown in Figure 1. The antenna is of the size 60mm X 56 mm, contains two parasitic elements and is fed by a 50- Ω microstrip line. Both radiating patch, ground plane and the feed-line are printed on the photographic paper substrate, which has a thickness of 0.23mm and a dielectric constant of 3.0. The microstrip line is offset in the horizontal direction from the middle of the ground plane. To excite three bands for the WLAN and WiMAX system, the partial radiating patch is modified by inserting a double U-slot strip. Two removed triangular bevel slots play an important role in the multiband characteristics and the coupling between the ground plane and the radiating patch [13].

Figure 2 shows the front view of proposed fabricated antenna and Figure 3 shows the bottom view of proposed fabricated antenna. A rectangular radiating patch with two removed triangles and offset fed is optimised to operate in frequency bands from 2.4GHz to 6 GHz. The double U slots gives three current path which results in three different frequency bands which covers the WLAN and WiMAX. The two parasitic elements are inserted in the proposed antenna design. The parasitic patch configuration improves the bandwidth of a typical microstrip antenna. The gain of the antenna is increased by using the gap-coupled configurations. In this type of antenna design, patches are placed near the edges of the original patch. These new patches may be coupled to the main patch electro-magnetically [14].

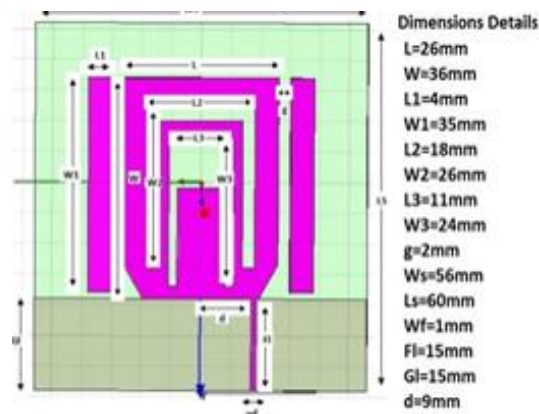


Figure 1. Geometry of Proposed Antenna

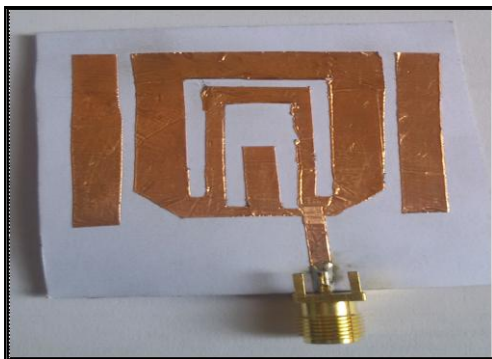


Figure 2. Front View of Fabricated Antenna

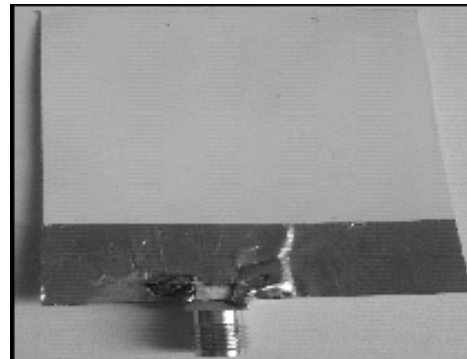


Figure 3. Bottom View of Fabricated Antenna

3. RESULTS AND DISCUSSION

The performance analysis of the proposed antenna is done by HFSS. Then the antenna is fabricated and tested on Vector Network Analyser (VNA). The results on VNA of reflection coefficients S11 and VSWR are shown in Figure 4 and Figure 5. It can be seen that the antenna can operate in three frequency bands operates at 2.6 (2.10-2.95), 3.45 (3.35-3.54) and 5.5 (5.04-6.0) GHz. These frequency bands cover the WLAN IEEE 802.11b (2.4-2.48 GHz), 802.11 a/n (5.15-5.35, 5.75-5.825 GHz), and WiMAX standards of band I (2.6-2.7GHz), band II (3.4-3.69GHz), and band III (5.25-5.825GHz). Table 1 gives the comparison of simulated and measured values for the multiband microstrip antenna. The gain is 3.2dB for simulation of antenna in HFSS and 2.8dB for fabricated antenna. The gain of the antenna is not perfect, however, considering the length and width of the microstrip-fed line and the electromagnetic property of the photographic paper (the loss tangent is 0.06), the value is acceptable wholly. Table 2 shows the all the application of the proposed antenna and gives the details of the bandwidth and gain required for the particular application.

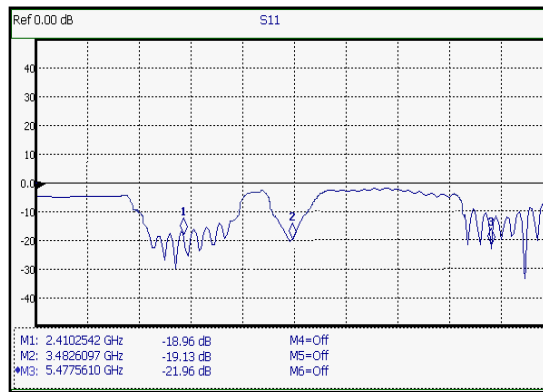


Figure 4. Return Loss of Fabricated Antenna on VNA

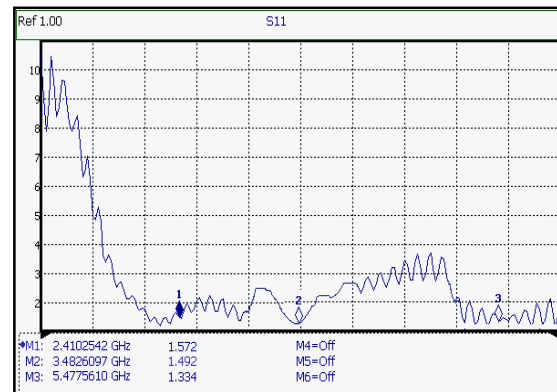


Figure 5. VSWR of Fabricated Antenna on VNA

Table 1. Comparison of Simulated and Measured Values Microstrip Antenna

Results	Freq (GHz)	Return loss (dB)	VSWR	Bandwidth (MHz)	Gain (dB)
Simulated Results	2.20-3.10	-14.77	1.47	900	3.2
	3.32-3.52	-12.06	1.68	200	
	5.17-6.12	-13.09	1.56	950	
Measured Results	2.10-2.95	-18.96	1.33	850	2.8
	3.35-3.54	-19.13	1.49	190	
	5.04-6.0	-21.09	1.56	960	

Table 2. Detail Requirements of Application of the Proposed Antenna

Application	Standard frequency band (MHz)	Required Bandwidth (MHz)	Standard gain Required
Bluetooth	2401-2480	80	5.0 dBi
Wi-Fi	2400-2500	100	
ZigBee	2410-2480	70	
ISM 2.4GHz	2400-2483	83	
WLAN			
WiMAX	3600-3800	200	
WLAN 5.2GHz	5150-5350	200	

4. CONCLUSION

In this paper a Multiband microstrip offset fed antenna with parasitic element is designed and fabricated using photographic paper substrate. Results show that we achieved three bands which cover applications under WLAN /Wimax. It is clear that antenna with photographic paper substrate are promising candidate for wireless communication.

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